

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Kenneth F. Buechler
Title: DIAGNOSTIC DEVICES AND
APPARATUS FOR THE
CONTROLLED MOVEMENT OF
REAGENTS WITHOUT
MEMBRANES

App. No.: Not yet assigned

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Examiner: Not yet assigned

Art Unit: Not yet assigned

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PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Sir:

In connection with the continuation application filed herewith, please enter the following amendments and consider the following remarks.

IN THE SPECIFICATION

Please cancel the first paragraph on Page 1 of the parent specification, Application No. 09/613,650, and substitute the following:

This application is a continuation-in-part of U.S. Patent Application No. 09/613,650 (pending), which is a continuation-in-part of U.S. Patent Application No. 08/828,041, now issued Patent No. 6,156,270, which is a continuation in part of U.S. Patent Application No. 08/447,895, which issued as U.S. Patent No. 6,019,944 on February 1, 2000, which is a divisional applications of U.S. Patent Application No. 08/065,528 (abandoned), filed 19 May 1993, which was a continuation-in-part of U.S. Patent Application No. 07/887,526 filed 21 May 1992 which

issued as Patent No. 6,143,576, which is a continuation in part of U.S. Patent Application No. 08/447,981, which issued as U.S. Patent No. 5,885,527 on March 23, 1999, which is a divisional application of U.S. Patent Application No. 08/065,528 (abandoned), filed 19 May 1993, which was a continuation-in-part of U.S. Patent Application No. 07/887,526 filed 21 May 1992 which issued as Patent 5,458,852 on October 17, 1995; and U.S. Patent Application No. 08/902,775 which issued U.S. Patent No. 6,271,040, which is a continuation in part of U.S. Patent Application No. 08/810,569 which issued as Patent No. 6,143,576, from each of which priority is claimed, and each of which is fully incorporated by reference herein.

IN THE CLAIMS

Please cancel claims 1-73 provided in the original specification and enter the following new claims: These new claims are reflected in the specification filed herewith.

74. A method for regulating fluid flow in a device that conducts fluid through one or more capillary channels, comprising:
- introducing fluid into a capillary channel comprising (i) a first capillary region comprising a hydrophilic surface and (ii) a second capillary region comprising a hydrophobic surface adjacent to said first capillary region, whereby fluid flows through said first capillary region to contact said hydrophobic surface.
75. The method of claim 74, wherein said device further comprises a third capillary region comprising a hydrophilic surface adjacent to said second capillary region, wherein said hydrophobic surface controls the rate of flow of said fluid into said third capillary region.
76. The method of claim 75, wherein said hydrophobic surface delays fluid flow into said third capillary region until rendered hydrophilic.
77. The method of claim 74, wherein said device comprises a plurality of capillary channels, one or more of which comprise a region comprising a hydrophobic surface.
78. The method of claim 75, wherein said device further comprises a vent.

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79. A method for regulating fluid flow in a device that conducts fluid through one or more capillary channels, comprising:

contacting said fluid with one or more hydrophobic regions on a capillary surface that alter a rate or direction of said fluid flow within said device in comparison to a rate or direction of fluid flow within said device in the absence of said hydrophobic region.

80. The method of claim 79, further comprising contacting said fluid with a first capillary region and a second capillary region adjacent to said first capillary region, wherein a difference in capillarity of said first capillary region compared to said second capillary region alters a rate or direction of said fluid flow within said device in comparison to the rate or direction of said fluid flow within said device in the absence of said difference in capillarity.

81. The method of claim 79, further comprising contacting said fluid with a reagent dried on a surface of the device, whereby said reagent dissolves into said fluid, thereby lowering the surface tension of said fluid.

82. The method of claim 79, wherein said device comprises a plurality of capillary channels.

83. The method of claim 79, wherein one or more of said hydrophobic regions are flanked by hydrophilic regions.

84. The method of claim 79, wherein at least one of said hydrophobic regions alter the rate of flow within said device.

85. The method of claim 84 wherein said hydrophobic region(s) that alter the rate of flow within said device retard fluid flow until rendered hydrophilic.

86. A device that conducts fluid through one or more capillary channels, comprising:

a capillary channel comprising (i) a first capillary region comprising a hydrophilic surface and (ii) a second capillary region comprising a hydrophobic surface adjacent to said first capillary region.

87. The device of claim 86, wherein said device further comprises a third capillary region comprising a hydrophilic surface adjacent to said second capillary region.

88. The device of claim 86, wherein said hydrophobic surface alters a rate or direction of fluid flow within said device.

89. The device of claim 86, further comprising a reagent dried on a surface of the device that, when dissolved into reagent dissolves into fluid within said device, lowers the surface tension of said fluid.

90. The device of claim 86, wherein said device comprises a plurality of capillary channels.

91. A method for regulating fluid flow in a device that conducts fluid through one or more capillary channels, comprising:

introducing fluid into a capillary channel comprising (i) a first capillary region comprising a surface having a first contact angle and (ii) a second capillary region adjacent to said first capillary region comprising a surface having a second contact angle less than that of said first contact angle, whereby fluid flows through said first capillary region to contact said second capillary region.

92. The method of claim 91, wherein said device further comprises a third capillary region adjacent to said second capillary region comprising a surface having a third contact angle greater than that of said second contact angle, wherein the rate of flow of said fluid into said third capillary region is regulated by the flow of fluid through said second capillary region.

93. The method of claim 92, wherein said second capillary region delays fluid flow into said third capillary region until said second contact angle is increased.

REMARKS

The new Specification submitted herewith is the same Specification filed with U.S. Application No. 09/613,650. However, Applicant has amended the Cross-Reference to related Patent Application section on Page 1 of the Specification and has written new claims which are now included as Pages 64-66. The new Specification contains all of these amended pages and therefore marked-up pages have not been provided.

The instant claims relate to methods and devices that regulate the flow of fluid through a capillary channel using differences in wettability of capillary surfaces to control the forces driving that flow. Particularly, a first surface region within the capillary can be placed adjacent to a second region having a reduced contact angle relative to the first surface region. Fluid traversing the first region can be induced to change direction or rate of flow upon contacting the second region.

The new claims are fully supported by the specification as filed, and do not introduce new matter. For convenience, the following citations of specific support refer to U.S. Patent Nos. 6,019,944 and 6,156,270, which are incorporated by reference in the instant application, and from which the instant application claims priority.

Methods and devices comprising a capillary surface in which fluid traversing a first capillary region comprising a hydrophilic surface to contact a hydrophobic surface can be found, e.g., in U.S. Patent 6,019,944, column 8, line 1, through column 11, line 37, and U.S. Patent No. 6,156,270, column 5, lines 40-50; inducing a change direction or rate of flow upon contacting the second region in U.S. Patent 6,019,944, column 8, lines 10-20 and column 9, lines 27-30; devices comprising a plurality of capillary channels in U.S. Patent No. 6,156,270, column 4, lines 29-30; devices comprising a vent in U.S. Patent No. 6,156,270, column 4, line 36; devices further comprising regions in which differences in capillarity induce a change in direction or rate of flow in U.S. Patent No. 6,156,270, column 9, lines 60-65, and column 14, line 62, through column 15, line 8; dried reagents that alter the surface tension of a fluid in U.S. Patent No. 6,019,944, column 5, line 67, through column 6, line 4.

Additionally, the term "contact angle" is well known to those of skill in the art as referring to an equilibrium orientation formed at the interface of a liquid and a solid surface, and is often used in reference to fluids within capillary spaces. The contact angle is related to the van der Waals interaction of fluid molecules for each other and for surface molecules, and thus is related to the composition of the fluid and the surface. For example, the skilled artisan understands that a fluid and a surface that is wettable by that fluid (*e.g.*, an aqueous solution and a hydrophilic surface) will exhibit a contact angle that is greater than the contact angle of the same fluid and a non-wettable surface (*e.g.*, an aqueous solution and a hydrophobic surface). Capillary force is related to surface tension of the fluid and the contact angle.

CONCLUSION

In view of the foregoing amendments and remarks, Applicants respectfully submit that the pending claims are in condition for allowance. An early notice to that effect is earnestly solicited. Should any matters remain outstanding, the Examiner is encouraged to contact the undersigned at the address and telephone number listed below so that they may be resolved without the need for additional action and response thereto.

Respectfully submitted,

Date October 18, 2001

By 

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